LOCTITE®

LOCTITE® 3D IND6845™

Tough
Matte Black

LOCTITE®
Henkel Corporation
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LOCTITE 3D IND6845™

LOCTITE 3D IND6845 offers a solid balance of moderately high Heat Deflection Temperature (HDT) and toughness.

LOCTITE 3D IND6845 produces parts with smooth surfaces and fine details. In addition to its toughness, it has excellent impact resistance making it suitable for parts that are subject to wear and mechanical stress.

LOCTITE 3D IND6845 is TPO-free which contributes to better safety ratings in manufacturing environments.

Benefits:

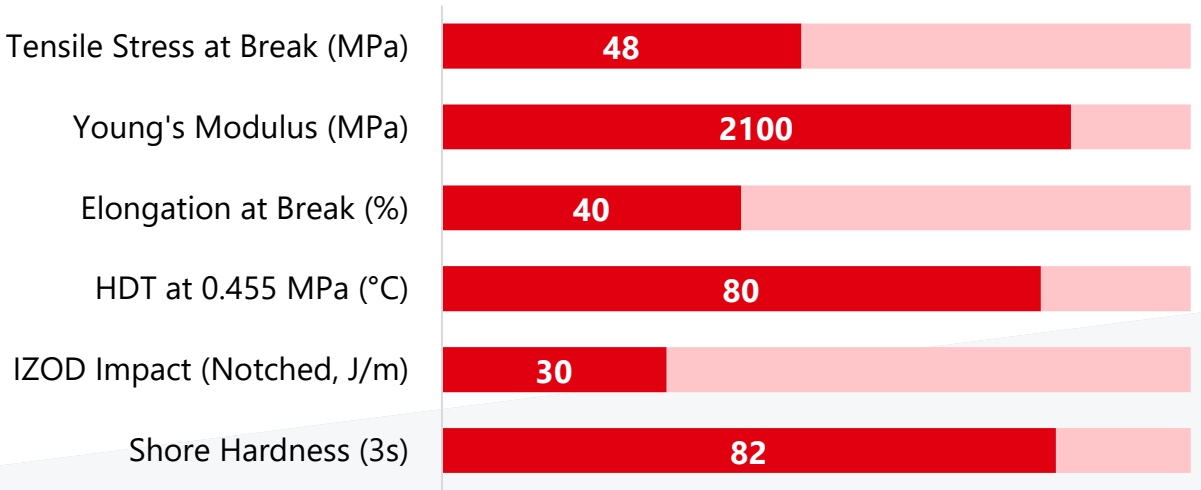
- TPO-free and excellent H&S rating
- Unique balance of HDT and toughness
- Increased print speed

Ideal for:

- General industrial applications
- General end-use plastic parts
- Jigs, tooling, fixtures

Markets:

Industry | Automotive | Consumer Goods



Values shown are linked to LOCTITE IND6845 BK as reference.

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PROPERTIES

Mechanical Properties	Measure	Method	Green	Post Processed
Young's Modulus	MPa	ASTM D638	1680 – 1830[1]	1980 - 2200[1]
Tensile Stress at Yield	MPa	ASTM D638	41 – 43[1]	55 - 59[1]
Elongation at Yield	%	ASTM D638	4.1 – 4.6[1]	4.4 – 5.6[1]
Tensile Stress at Break	MPa	ASTM D638	32 – 34[1]	47 – 49[1]
Elongation at Break	%	ASTM D638	56 – 64[1]	35 – 45[1]
Poisson's Ratio	-	ASTM D638	-	0.35 – 0.41[16]
Flexural Modulus	MPa	ASTM D790	-	1960 – 2300[15]
Flexural Stress at Break	MPa	ASTM D790	-	80 – 95[15]
Flexural Elongation at Break	%	ASTM D790	-	≥5[15]
IZOD Impact (Notched)	J/m	ASTM D256	-	28 – 35[5]
Shore Hardness (3s)	D	ASTM D2240	-	76 – 78[15]
Other Properties				
HDT at 0.455 MPa	°C	ASTM D648	-	80 – 85[3,4]
HDT at 1.82 MPa	°C	ASTM D648	-	62 – 68[3,4]
Water Absorption (24hr)	%	ASTM D570	-	2.1 – 2.5[2]
Water Absorption (48hr)	%	ASTM D570	-	2.7 – 3.1[2]
Water Absorption (72hr)	%	ASTM D570	-	3.3 – 3.7[2]
Solid Density	g/cm^3	ASTM D1475	-	1.16 - 1.20[2]
Thermal Conductivity	W/(m·K)	ASTM D5930	-	0.20 – 0.21[12]
Heat Capacity	J/(g·K)	ASTM D5930	-	1.2 – 1.3[12]
Horizontal Burning Test	-	UL94	-	HB at 1.6 mm[13]

Test parameters:
All specimen are printed unless otherwise noted. All specimen were conditioned in ambient lab conditions at 19-23°C / 40-60% RH for at least 24 hours. ASTM Methods: D638 Type IV, 5 mm/min, D790-B, 1.3 mm/min, D648, D256 Notched IZOD (Machine Notched), 6 mm x 12 mm, D570 0.125" x 2" Disc 24hr@ 25°C, D2240, Type "D" (0, 3 seconds), D7867, D1475
*The biological assessment has been performed based on the in vitro method according to ISO10993-23

Internal Data Sources:
[1] GEN730945 [2] FOR727326, [3] FOR716969, [4] FOR727226, [5] FOR729752, [12] FOR729029 [13] FOR728833, [15] FOR779087, [16] FOR796555

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PROPERTIES

Liquid Properties	Measure	Method		Value
Viscosity at 25°C (77°F)	cP	ASTM D7867		650 – 850 [7]
Liquid Density	g/cm³	ASTM D1475		1.07 [8]
Biocompatibility				
Cytotoxicity		ISO10993-5	-	Comply [14]

Electrical Properties	Measure	Method	Green	Post Processed
Volume Resistivity	Ω·cm	ASTM D257	-	$5.1 \cdot 10^{15}$ – $3.7 \cdot 10^{15}$ [10]
Surface Resistivity	Ω	ASTM D257	-	$9.9 \cdot 10^{15}$ – $8.1 \cdot 10^{15}$ [10]
Dielectric Strength	kV/mm	ASTM D149	-	14.4 – 13.8[16]
AC Relative Permittivity (Dielectric Constant)				
at 50 Hz (XY)	none	ASTM D150	-	4.0 - 5.1[16]
at 1 kHz (XY)	none	ASTM D150	-	4.2 – 4.8[16]
at 1 MHz (XY)	none	ASTM D150	-	3.8 - 4.3[16]
AC Loss Characteristic (Dissipation Factor)				
at 50 Hz (XY)	none	ASTM D150	-	0.11 – 0.29[16]
at 1 kHz (XY)	none	ASTM D150	-	0.08 – 0.10[16]
at 1 MHz (XY)	none	ASTM D150	-	0.13 – 0.17[16]

Internal Data Sources:
[7] FOR724418 [8] GEN793207, [10] FOR728734, [14] FOR764957, [16] FOR748297

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WORKFLOW

Validated workflows need to be followed to achieve properties as provided in the TDS. Examples of validated workflow steps are listed below. Users should defer to the most current workflow information for best results which can be found at https://www.loctiteam.com/printer-validation-settings

PRINTER SETTINGS

LOCTITE 3D IND6845 BK is formulated to print optimally on DLP and LCD printers. Read the safety data sheet carefully to get details about health and safety instructions. Recommended print parameters:

- Shake resin bottle well before usage
- Temperature: 20°C to 35°C
- Intensity: 1.5 mW/cm² to 5 mW/cm²

Printer Settings			385 nm and 5.0 mW/cm²	405 nm and 1.75 mW/cm²
Parameter	**Measure**	**Method**	**Exposure time**	**Exposure time**
Layer Thickness	µm	Internal	100	100
Burn-in Region	s	Internal	5	25
Transition Region	s	Internal	-	16
Model Region	s	Internal	5.5	8

Parameter	**Measure**	**Method**	**Value**	**Value**
E_C	mJ/cm2	Internal	9.3[11]	5.1[12]
D_P	mm	Internal	0.16[11]	0.16[12]

Settings	**Measure**	**Method**	**Exposure time**	**Exposure time**
D_C = 50 µm	s	Internal	1.76*[11]	3.6*[12]
D_C = 100 µm	s	Internal	2.80*[11]	5.3*[12]

Test parameters:
*Exposure times are calculated without a safety factor

Internal data source:
[11] FOR723725, [12] FOR718034

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CLEANING

LOCTITE 3D IND6845 BK requires post processing to achieve specified properties. Prior to post curing, support structures should be removed from the printed part, and the part should then be washed. Use compressed air to remove residual solvent from the surface of the material between intervals.

Post Process Step	Agent	Method	Duration	Intervals	Additional Info
Cleaning Step #1	Cleaner C	Ultrasonic	2 min	1 or 2	Dry after each interval
Cleaning Step #2	IPA	Ultrasonic	1 min	1	
Dry	n.a.	Compressed air	10 s to 60 s	1	Air pressure (50psi)
Wait before post curing	n.a.	Ambient condition	60 min	1	Room temperature

POST CURING

LOCTITE 3D IND6845 BK requires a two-step post curing to achieve specified properties. In the first step it is recommended that either an LED or wide spectrum lamp be used to UV post cure parts. In the second step the UV post cured parts require an additional Heat post cure to achieve final properties.

STEP 1: UV post cure

UV Curing Unit	UV Source	Intensity	Cure time per side	Additional Settings (Shelf, Output Energy)
Loctite CL36	405nm LED	80 mW/cm² at 405 nm	30 min	100% top and side
Prusa CW1S	405nm LED	15 mW/cm² at 405 nm	30 min	100%

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Validated workflows need to be followed to achieve properties as provided in the TDS. Examples of validated workflow steps are listed below. Users should defer to the most current workflow information for best results which can be found at https://www.loctiteam.com/printer-validation-settings

POST CURING

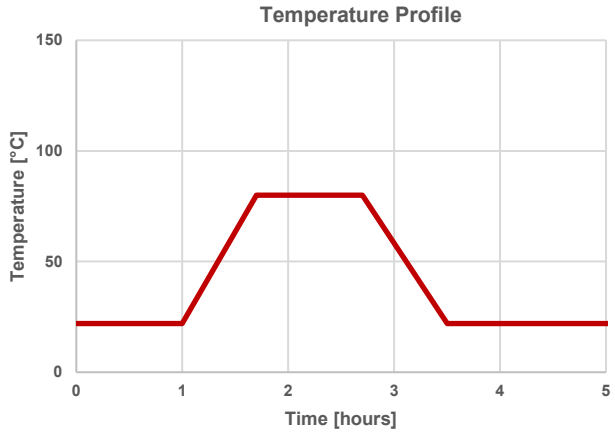
LOCTITE 3D IND6845 BK requires a two-step post curing to achieve specified properties.

STEP 2: Heat post cure – Using a printer at 405 nm

After UV post curing, an additional Heat post cure at 80°C for 1 hours is required to reach final properties. Let parts rest one hour between UV post cure and Heat post cure.

To minimize risk of warpage place parts in the oven at standard lab conditions with T_{start} = 22°C before ramping temperature with are rate of $R_T \leq 5$°C/min to target value of T_{cure} = 80°C.

After 1 hour at T_{cure} = 80°C cool down parts slowly in the switched off oven to standard lab conditions with T_{end} = 22°C. Do not remove the parts from the oven before they reached lab temperature to prevent thermal stress and warpage.



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TIPS & TRICKS

This section is a collection of useful advices, guides, and recommendations designed to help users of LOCTITE 3D IND6845 BK deal with specific process tasks more efficiently.

STORAGE

Store LOCTITE 3D IND6845 BK in the unopened container in a dry location. Optimal Storage: 20°C to 30°C. Storage below 20°C or above 30°C can adversely affect product properties. .

RESIN USE

Use LOCTITE 3D IND6845 BK within two weeks after having opened the bottle to assure stable mechanical properties. Material removed from containers may be contaminated during use. For this reason, filter used resin with 190 µm mesh filter before placing back into proper storage container. Please use a separate container for used resin.

Reduce exposure to ambient light to achieve best resin performance.

POST PROCESSING

Please start the post processing of LOCTITE 3D IND6845 BK within 24 hours after the print is finished. Gently remove green parts from the platform to achieve best part performance.

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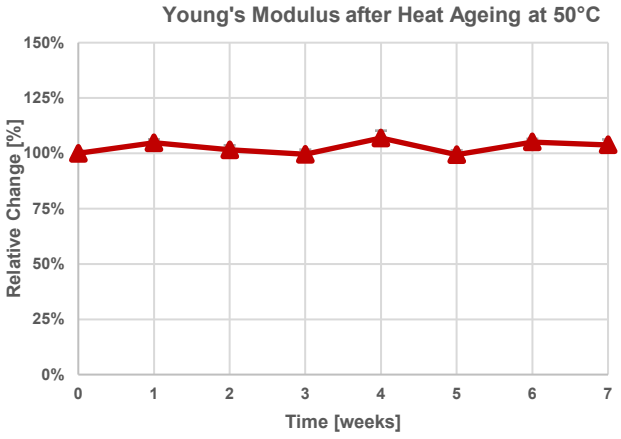
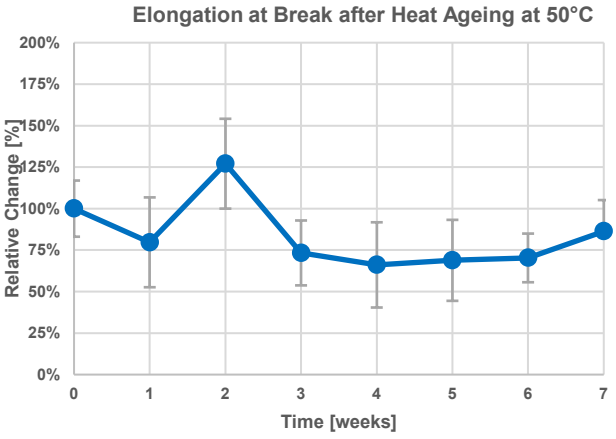
AGEING AND ENVIRONMENTAL EFFECTS – HEAT AGEING

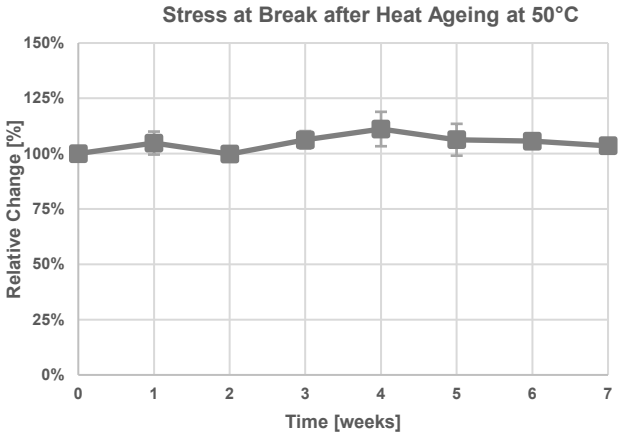
LOCTITE 3D IND6845 BK was heat aged without load according to ASTM D3045. Test samples were exposed for a defined time at 50°C and conditioned for 24 hours at 22°C before mechanical testing. Control samples were stored at a constant 22°C. All samples were printed in the same print job using a validated workflow. Mechanical testing was conducted according to ASTM D638 at standard lab conditions (22°C).

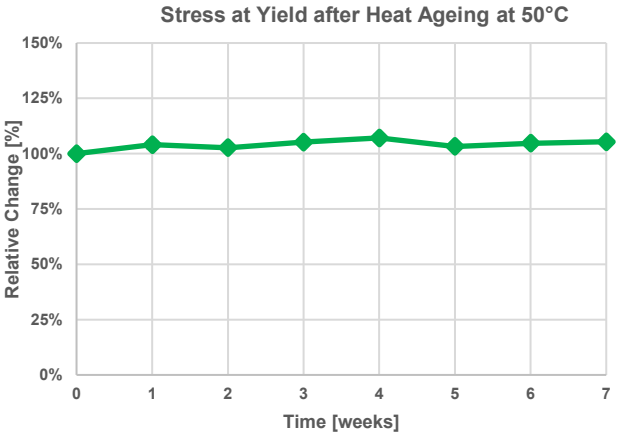
Values at '0 weeks' are non-aged samples stored at 22°C and tested after 24 hours of post-processing.

Based on temperature dependence of reaction rates a test time of 6 weeks at 50°C can be interpreted as approximately 12 months at ambient temperature.









Test parameters:
ASTM D638: Type IV, Pull speed: 5 mm/min, Young's modulus measured at 0.1-1.0% (regression), 22°C

Internal Data Sources:
FOR783017, FOR783022

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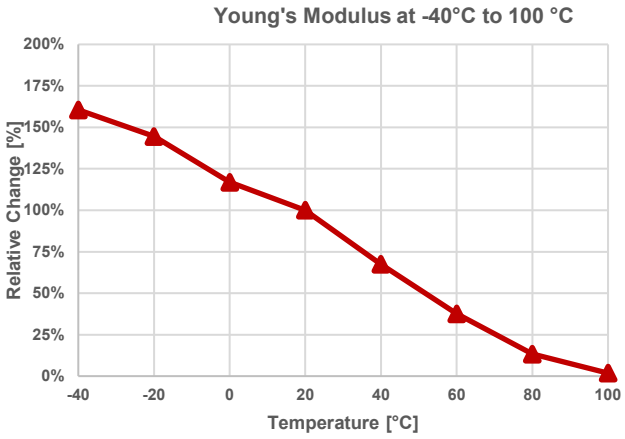
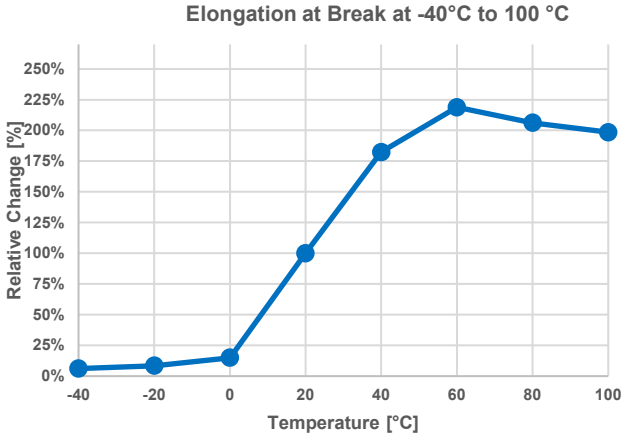
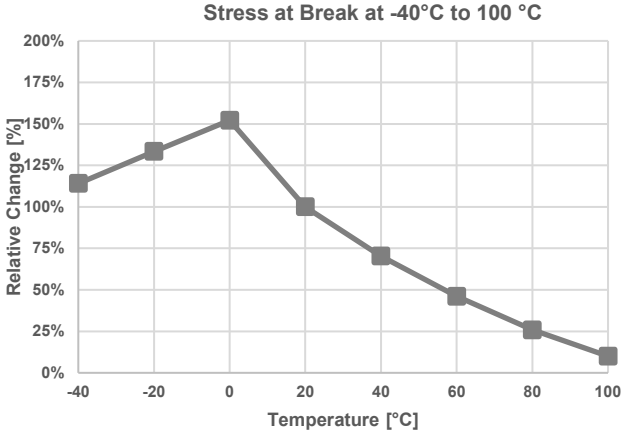
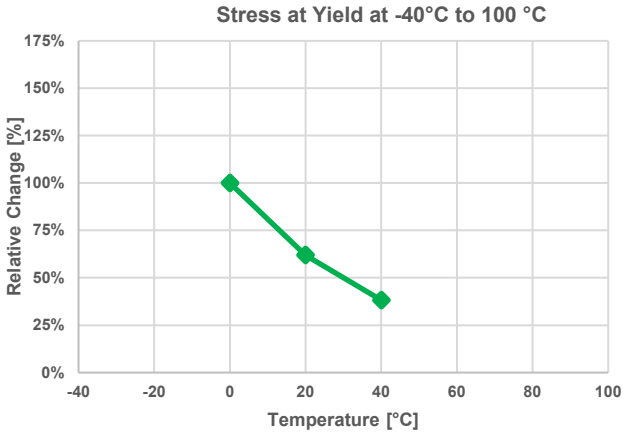
THERMAL INFLUENCE ON MECHANICAL PROPERTIES

LOCTITE 3D IND6845 BK was tested according to ASTM D638 at varied environmental temperatures, from -40°C to 100°C. All samples were printed in the same print job using a validated workflow. Mechanical testing was conducted according to ASTM D638. Before each test series samples were conditioned for 60 minutes at the specific test temperature.









Test parameters:
ASTM D638, Type IV, Pull speed: 5 mm/min, Young's modulus measured at 0.1-1% (regression)

Internal Data Sources:
[1] FOR739355

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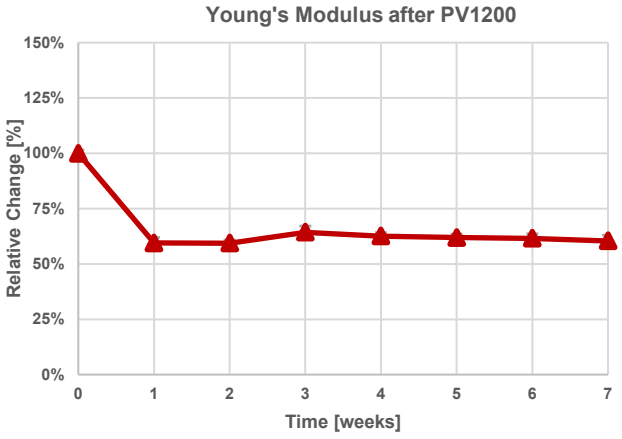
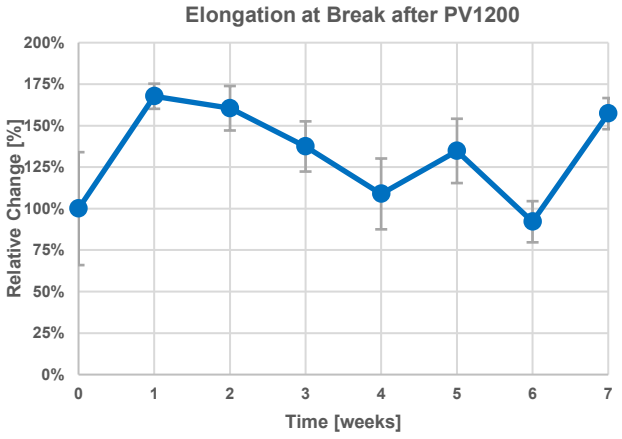
AGEING AND ENVIRONMENTAL EFFECTS – CLIMATE CYCLING TEST (PV1200)

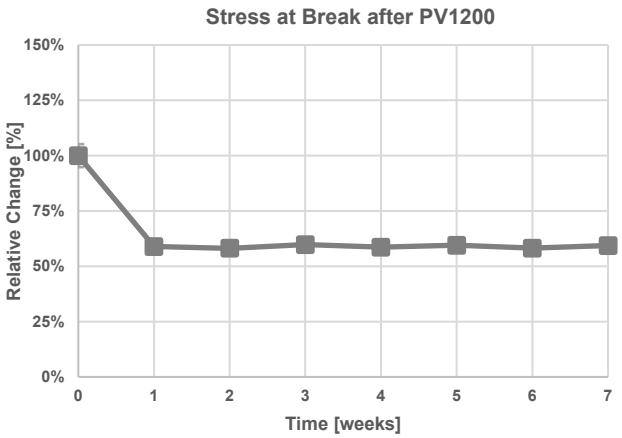
LOCTITE 3D IND6845 BK was tested in an environmental climate cycling test according to PV1200 specification. This specification was developed by Volkswagen AG to evaluate material durability and cycles between -40°C (4 hours) and 80°C (4 hours at 80 % rel. humidity) during a repeating 12-hour cycle. Test samples were exposed to this temperature cycle for a total duration of 7 weeks (100 cycles).

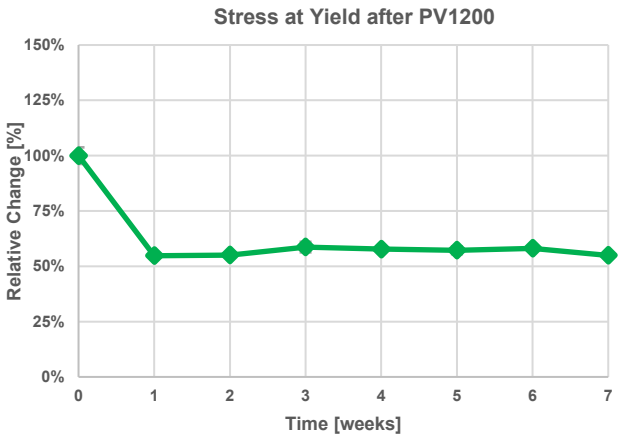
Before mechanical testing samples were conditioned for 24 hours at 22°C. Control samples were stored at a constant 22°C. All samples were printed in the same print job using a validated workflow. Mechanical testing was conducted according to ASTM D638 at standard lab conditions (22°C).

Values at '0 weeks' are non-aged samples stored at 22°C and tested after 24 hours of post-processing.









Test parameters:
ASTM D638: Type IV, Pull speed: 5 mm/min, Young's modulus measured at 0.1-1.0% (regression), 22°C
PV1200: Samples were removed from climate chamber during heating phase (Cycle time: 240-300 minutes) and then conditioned for 24 hours at 22°C. One Test cycle is equal to 12 hours of test time. "7 weeks" of test time represent 100 test cycles or 1200 hours of test time.

Internal Data Sources:
FOR787474, FOR787478

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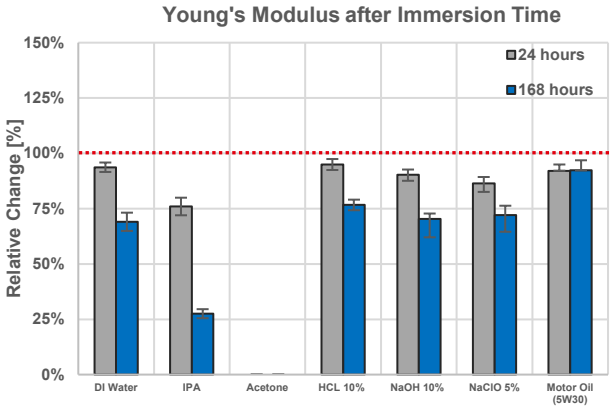
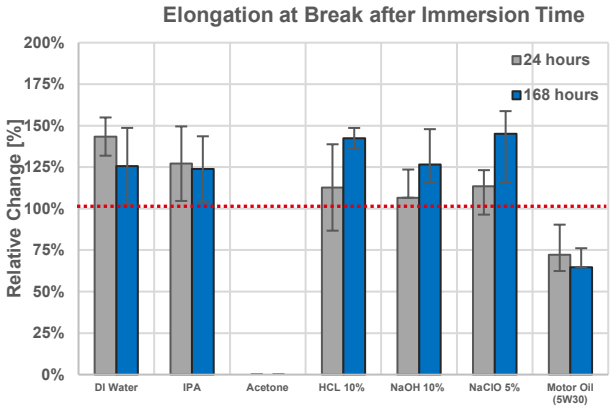
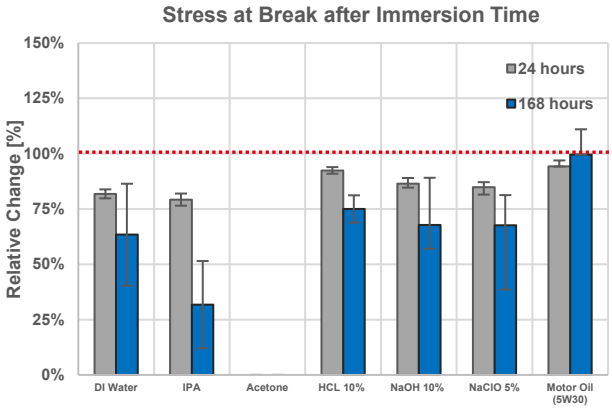
AGEING AND ENVIRONMENTAL EFFECTS – CHEMICAL RESISTANCE INDUSTRIAL

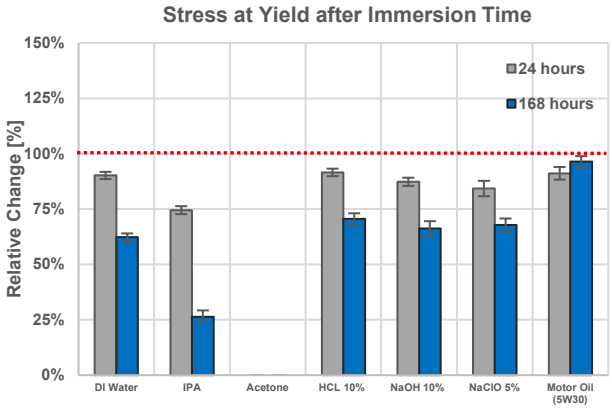
LOCTITE 3D IND6845 BK was tested after chemical ageing according to ASTM D543. The influence of chemicals was tested by measuring mechanical properties after different test times (Immersion test for 24 and 168 hours). Exposed samples were stored in containers and fully immersed in different chemicals. Samples were stirred every 24 hours using a shaker. After removal, exposed samples were washed and conditioned for 24 hours at 22°C before mechanical testing. All samples were printed using a validated workflow. Mechanical testing was conducted according to ASTM D638 at standard lab conditions (22°C).

The 100% value represents the initial weight 24 hours after post-processing.









Test parameters:
ASTM D638: Type IV, Pull speed: 5 mm/min, Young's modulus measured at 0.1-1.0% (regression), 22°C
ASTM D543: Samples immersed in different chemicals were stored at 22°C. Samples immersed in Motor Oil were stored at 50°C.
Properties of media used: pH(HCl 10%) = 1; pH(NaOH 10%) = 14; pH(NaClO 5%) = 13

Internal Data Sources:
FOR730344, FOR730345, FOR730349, FOR730353, FOR752206, FOR752207, FOR752209

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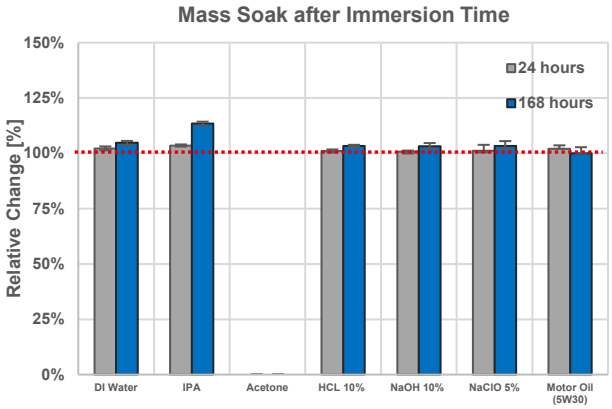
AGEING AND ENVIRONMENTAL EFFECTS – CHEMICAL RESISTANCE MASS SOAK

LOCTITE 3D IND6845 BK was tested after chemical ageing according to ASTM D543. The influence of chemicals was tested by measuring the mass change after different test times (Immersion test for 24 and 168 hours). Exposed samples were stored in containers and fully immersed in different chemicals. Samples were stirred every 24 hours using a shaker. After removal exposed samples were washed, dried and immediately weighed. All samples were printed using a validated workflow.

The 100% value represents the initial weight 24 hours after post-processing.



Test parameters:
ASTM D543: Samples immersed in different chemicals were stored at 22°C. Samples immersed in Motor Oil, Transmission Oil and Coolant mix 1:1 were stored at 50°C.
Properties of media used: pH(HCl, 10%) = 1; pH(NaOH 10%) = 14; pH(NaClO 5%) = 13; pH(H_2SO_4 30%) = 0; pH(H_2O_2 30%) = 5; pH (NaCl solution 0.9%) = 5
Viscosity: Hydraulic fluid = 3000 mPas at 40°C; Transmission oil = 8200 mPas at 40°C;
Minimum temperature for coolant mix 1:1 = -40°C

Internal Data Sources:
FOR730344, FOR730345, FOR730349, FOR730353, FOR752206, FOR752207, FOR752209

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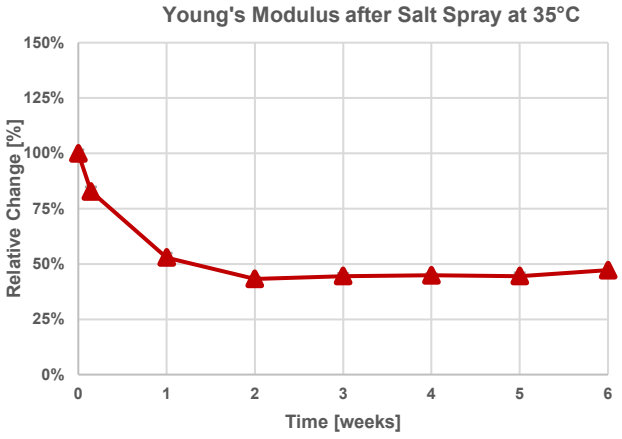
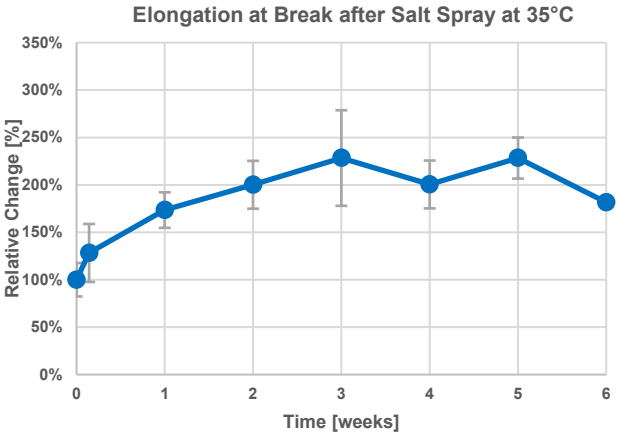
AGEING AND ENVIRONMENTAL EFFECTS – SALT SPRAY EXPOSURE

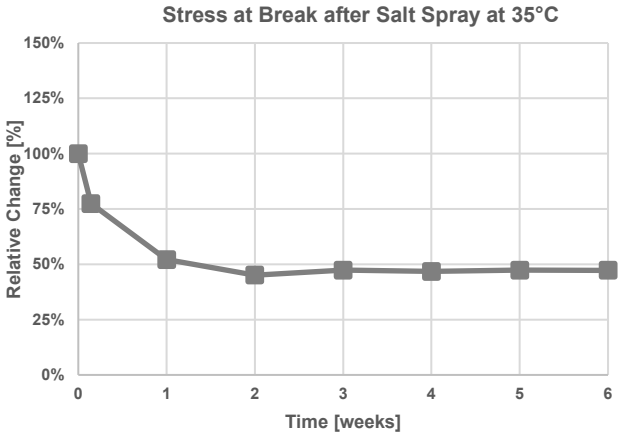
LOCTITE 3D IND6845 BK was aged according to ASTM B117-19. During the test samples were exposed to salt spray at 35°C. After removal from the test chamber, exposed samples were dried, inspected, cleaned using water and wiped dry. Before mechanical testing, samples were conditioned for 24 hours at 22°C. All samples were printed in the same print job using a validated workflow. Mechanical testing was conducted according to ASTM D638 at standard lab conditions (22°C).

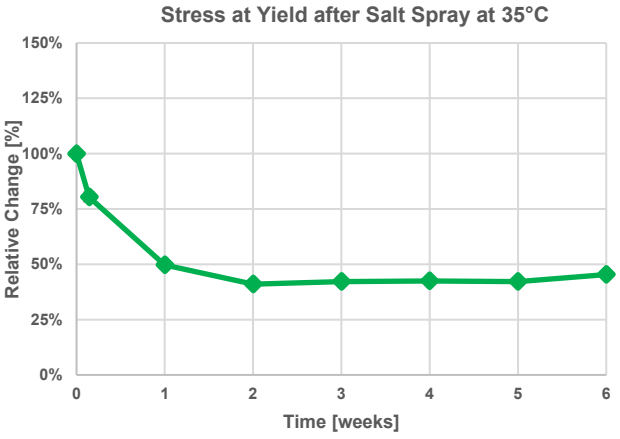
Values at '0 weeks' are non-aged samples stored at 22°C and tested after 24 hours of post-processing.

Please note, accelerated weathering testing can never fully represent real outdoor conditions and complexity. It is therefore recommended to conduct additional (outdoor) testing relevant for your specific application needs.









Test parameters:
ASTM B117-19: pH = 6.1; Fog collection = 1.3 ml/h
ASTM D638: Type IV, Pull speed: 5 mm/min, Young's modulus measured at 0.1-1.0% (regression), 22°C

Internal Data Sources:
FOR790072, FOR790085

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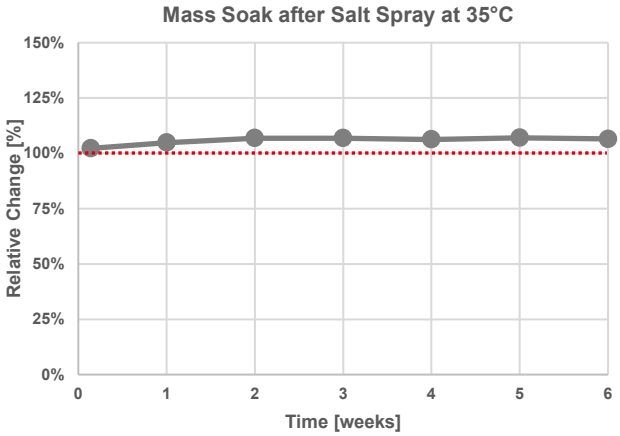
AGEING AND ENVIRONMENTAL EFFECTS – SALT SPRAY EXPOSURE

LOCTITE 3D IND6845 BK was tested after salt spray exposure according to ASTM B117-19. All samples were printed in the same print job using a validated workflow. After removal from the salt spray environment, exposed samples were dried, inspected, cleaned using water, wiped dry and immediately weighed.

The influence of the salt spray was measured by mass change after different exposure times. Samples were weighed after 24 hours and 1 to 6 weeks.

The 100% value represents the initial weight 24 hours after post-processing.



Test parameters:
ASTM B117-19: pH = 6.1; Fog collection = 1.3 ml/h

Internal Data Sources:
FOR790072, FOR790085

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NOTE

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